ASPECTS OF TREATMENT*

The Mobin-Uddin umbrella filter in the management of proven and threatened pulmonary embolism

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Summary

An umbrella filter was inserted into the inferior vena cava in 8 patients with proven or threatened pulmonary embolism. The technique was found to be simple and without major complication in this small series. Two patients died of their primary disease and a further 2 died of lung complications secondary to their initial embolism. The remaining 4 patients have been followed up for periods ranging from 2 to 11 months.

Introduction

According to the Registrar General's figures the number of deaths from pulmonary embolism in England and Wales in 1973 (the latest year for which information is available) was 6456. This, however, is likely to be an underestimate and the correct figure is probably 4–5 times greater[1].

Although pulmonary embolism is now recognized as a complication of calf thrombosis as well as more proximal thrombosis, emboli arising in the calf are probably never fatal[2] and thrombosis distal to the popliteal fossa is best treated conservatively by anticoagulant therapy. However, when embolization occurs from thrombosis proximal to the popliteal fossa there is frequently an initial small 'warning' embolism followed by a further embolism which in a large proportion of cases proves fatal[3]. This may occur despite full anticoagulation. Surgical techniques have therefore been developed to prevent emboli from reaching the pulmonary circulation and range from complete occlusion by ligation of the iliac veins or vena cava to partial occlusion by a variety of techniques, the latest of which is the Mobin-Uddin umbrella filter (Fig. 1). The partially occlusive techniques have the advantage over total occlusion that the cardiac venous return is only marginally reduced[4], a vital point in the critically ill patient[5].

Over 2000 of these filters have been inserted in the United States but surprisingly few in Britain. It is the aim of this paper to present the technique as simple, safe, and effective in preventing embolization to the pulmonary circulation.

Indications

The main indications for surgical intervention are three in number:

1) Embolization despite adequate anticoagulant therapy for clinically diagnosed and

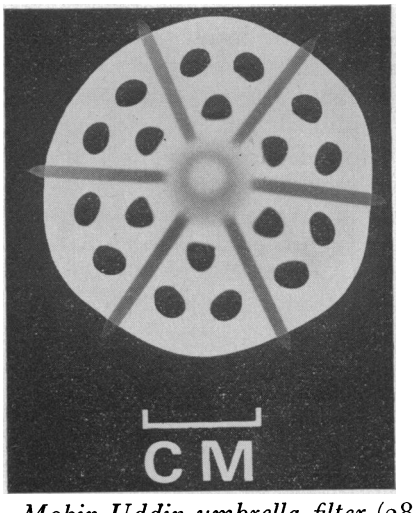

FIG. 1 *Mobin-Uddin umbrella filter* (28 *mm*) *showing perforated silicone rubber disc bonded on to* 6 *stainless steel struts.*

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* Fellows and Members interested in submitting papers for consideration with a view to publication in this series should first write to the Editor.

venographically confirmed iliofemoral venous thrombosis.

2) Patients with a recognized iliofemoral deep vein thrombosis in whom anticoagulant therapy is contraindicated because of a bleeding diathesis, a known lesion such as a peptic ulcer, steroid therapy, or proposed surgery, especially of the brain or spinal cord.

3) Repeated thromboembolic episodes.

Patients treated (see table)

Eight patients (3 female, 5 male) aged 36–69 (mean 60.3) years had an umbrella filter inserted into the inferior vena cava (IVC). Venography, which confirmed the clinical diagnosis of deep vein thrombosis, was carried out on 6, the 7th had a lung scan only, and the 8th was too ill owing to generalized peritonitis and massive pulmonary embolism for either lung scanning or venography to be carried out. In 5 of the 8 patients embolism occurred while they were on anticoagulant therapy; the remaining 3 patients could not be given anticoagulants because of impending surgery, including 2 brain operations. Those patients on anticoagulant therapy continued their therapy up to and after the operation, one dose only being omitted for the operation. Neither of the 2 patients with postoperative deep venous thrombosis and embolism had received subcutaneous heparin prophylaxis.

Method

The aim is to pass the collapsed Mobin-Uddin filter down into the IVC from a neck incision and 'open' the umbrella below the renal veins. The prerequisite before insertion is knowledge of the position of the kidneys and, by inference, the renal veins. This can be achieved by tomography or preferably by intravenous pyelography. Ideally, information should be obtained about the presence of thrombus in the IVC and of anatomical anomalies by means of a cavogram.

Under general or local anaesthesia a 5-cm incision is made 1 cm above and parallel to the medial end of the right clavicle. The two heads of the sternomastoid muscle are separated and the right internal jugular vein dissected out, with particular care for the adherent posterior wall of the vein. Occlusive slings 2–3 cm apart are placed around the internal jugular vein. The vein is opened and the capsule, preloaded according to the manufacturer's instructions, is inserted on its application guide wire. In all 8 patients the 28-mm filter was used rather than the 23-mm size. Insertion is facilitated by placing stay sutures at 4 points around the venotomy. Under X-ray control, preferably using an image intensifier, the capsule is guided into the lower IVC and the umbrella ejected, normally at the level of the lower border of the 3rd lumbar vertebra (Fig. 2). With slight countertraction the capsule is unscrewed and removed and the venotomy closed.

Only two minor difficulties in insertion have been encountered. In one patient transient spasm of the internal jugular vein was experienced. In another the capsule repeatedly entered the right renal vein; the capsule was withdrawn and the

Clinical features and outcome in 8 patients treated

	Age	*Factors contributing to deep venous thrombosis*	*Anticoagulation*	*Pulmonary embolism*	*Venography*	*Lung scan*	*Outcome*
1	65	Brain tumour	No	No	+ve	No	Dead/no PM
2	63	Nil found	Yes	Yes	+ve	+ve	Dead/PM
3	58	Brain abscess	No	No	+ve	No	Alive at 11/12
4	62	Postoperative	Yes	Yes	+ve	+ve	Alive at 9/12
5	69	Pelvic malignancy	No	Yes	No	+ve	Dead/no PM
6	62	Nil found	Yes	Yes	+ve	+ve	Alive at 5/12
7	67	Postoperative	Yes	Yes	No	No	Dead/PM
8	36	Iatrogenic	Yes	Yes	+ve	No	Alive at 2/12

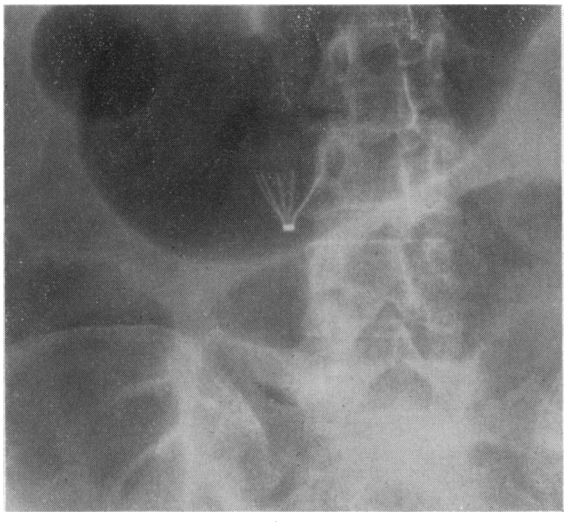

FIG. 2 *Plain abdominal X-ray 24 h after insertion of umbrella seen at the lower border of L3.*

distal end of the application wire slightly bent, whereupon the capsule was passed easily, its apex being rotated so as to point away from the right renal vein on its descent through the vena cava.

Results

Seven insertions were carried out under general anaesthesia and one under local anaesthesia.

Four patients died, 2 of recognized preoperative malignancy (Patients 1 and 5) and 2 because of lung complications secondary to their pulmonary embolism (Patients 2 and 7). Patient 2 had antibiotic-resistant lung abscesses and eventually died of acute bacterial endocarditis, while Patient 7 died after a prolonged period despite intermittent positive pressure ventilation with ever-increasing oxygen concentrations in his inspired air. This patient also had gross intra-abdominal sepsis which would have precluded conventional surgical procedures on the IVC or the iliac veins.

Repeated plain abdominal X-rays up to 11 months after surgery have all proved normal apart from Patient 4, who was found 36 hours after insertion to have a tilted umbrella very suggestive of a large embolus causing IVC dilatation and dislodgement of some of the tines (Fig. 3). Clinically there was no obstruction, as reflected by the lack of oedema.

Two patients (2 and 7) developed sudden massive oedema of both lower extremities 4 days and 36 hours respectively after insertion of the filter. While it seemed likely that a major embolus had been thrown off and had lodged under the umbrella, obstructing it completely, it was not considered ethical to investigate these patients by venography. Plain abdominal X-rays did not show tilting of the umbrella. However, Patient 7 died shortly after and at postmortem a fresh embolus was found distal to the filter (Fig. 4). In Patient 2 postmortem 3 months after insertion showed dense and completely organized thrombus distal to the umbrella and organized thrombus proximally up to but not involving the renal veins.

Four patients have survived and have been followed up for between 2 and 11 months. Their period of actual or proposed anticoagulation has been 6 months. Venous pressure studies[6] have been carried out on the 3 whose filters have been inserted for more than 3 months (the latest patient has not been studied but has no oedema clinically at 2 months). In all 3 patients (3, 4, and 6) the pressure in the unaffected leg is normal and in 2 patients there is slight elevation of the venous pressure in the leg which had been the site of deep venous thrombosis and the source of the emboli. Had their filters occluded with-

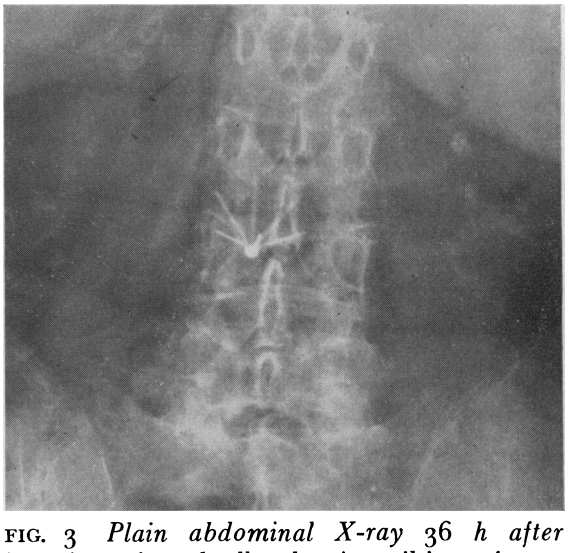

FIG. 3 *Plain abdominal X-ray 36 h after insertion of umbrella showing tilting of umbrella.*

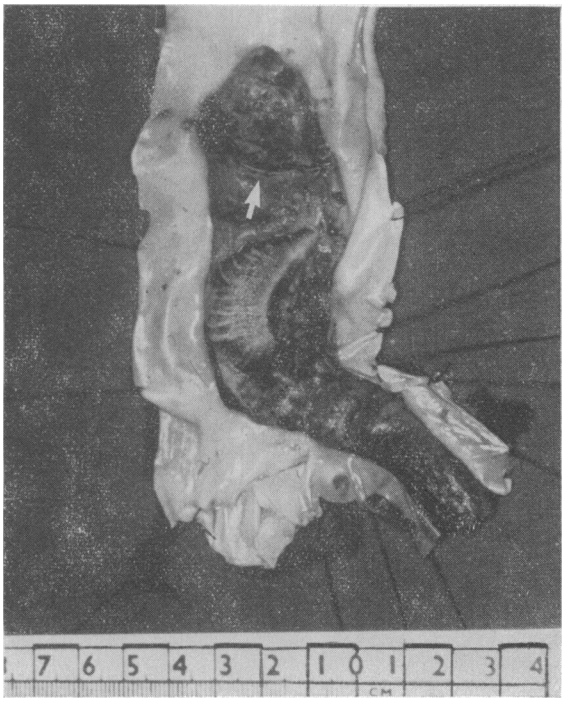

FIG. 4 *Postmortem specimen of lower IVC and left iliac vein with fresh embolus (note lines of Zahn) beneath umbrella (arrowed) and small amount of thrombus proximal to umbrella.*

out formation of a collateral circulation the pressure in the normal leg would presumably have been elevated.

Because of recurrent clinical thrombosis Patient 6 has had bilateral pedal venography which showed full patency of the filter at 6 months. However, this is the only patient in whom venography was felt to be justified.

All 4 surviving patients have also had repeat chest X-rays and lung scans and after resolution of their initial changes there have been no further changes suggestive of repeat embolism.

Discussion

In American series a variety of operative complications have been reported, including filter migration, duodenal perforation, and misplacement of the filter[7]. The majority of filter migrations have involved the smaller (23-mm) filter, but 2 cases of migration of the larger (28-mm) filter have been reported[8].

In the postoperative period late leg swelling ranging from 5 to 38% has been reported[8,9], together with local symptoms of phlebitis, pain, and ulceration[9]. However, in the present small series clinical examination and measurement of venous pressures have not confirmed the presence of venous hypertension, though the short follow-up period must be borne in mind.

Lastly, although recurrent pulmonary embolism rates of up to 3.0% have been reported[8], in this small series there has been no evidence of recurrent embolism to date.

Comment

The IVC umbrella filter appears to have distinct advantages over more conventional techniques. These advantages are:

1) Easy insertion under local anaesthesia or general anaesthesia.

2) Anticoagulation does not have to be stopped or reversed.

3) Insertion can be carried out in the presence of abdominal sepsis.

4) The need for a major surgical procedure is obviated.

5) Venous return to the heart is not obstructed.

6) Dissection in relation to previous abdominal surgery is avoided.

I would like to thank Professor H A F Dudley and Mr L L Bromley of St Mary's Hospital and the consultants, especially Mr E J Williams, of Wexham Park Hospital for permission to report their patients and also for help and advice in preparing this paper.

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